CLAIMS

1. An optical router comprising at least one frequency router having a plurality of input ports and a plurality of output ports, at least one input port simultaneously receives at least two optical signals to be frequency routed, and at least one output port simultaneously presenting at least two frequency routed optical signals, wherein each optical signal to be frequency routed is colored in response to destination information.

2. The optical router of Claim 1, further comprising:

a plurality of combiners, one combiner for combining the at least two optical signals to be routed; and

a plurality of receivers, one receiver for separating each of the at least two routed optical signals to intended destinations in response to destination information.

3. The optical router of Claim 2, wherein the frequency router routes optical signals by color, the at least two optical signals to be routed having different colors, and the at least two routed optical signals having different colors.

4. The optical router of Claim 3, wherein the optical router receives packets of data, each packet of data having destination information, each combiner coupled with at least one converter of a plurality, each converter converting at least one packet of data to an optical signal colored in response to the destination information of the corresponding at least one packet of data.

5. The optical converter of Claim 4, wherein the frequency router comprises:

at least one input waveguide;

at least one output waveguide;

a first and a second free space region, the first free space region coupled with the at least one input waveguide and the second free space region coupled with the at least one output waveguide; and

an optical grating having a plurality of unequal length waveguides, each unequal length waveguide coupled between the first free space region and the second free space region.

6. The optical router of Claim 5, wherein each receiver comprises:

at least two tunable filters; and

at least one splitter for splitting the at least two routed optical signals between the at least two tunable filters such that at least one of the at least two tunable filters is tuned to pass one of the at least two routed optical signals to an intended destination.

7. The optical router of Claim 5, wherein each receiver comprises:

at least two second stage converters;

at least one demultiplexer for separating each of the at least two routed optical signals into one of the at least two second stage converters, each second stage converter converting one of the routed optical signals to a second stage optical signal colored in response to the destination information of the corresponding at least one packet of data; and

at least one second stage combiner for combining second stage optical signals into a combined second stage optical signal to be frequency routed.

8. The optical router of Claim 7, further comprising:

a second stage frequency router having a plurality of second stage input ports and a plurality of second stage output ports, one second stage input port receiving the combined second stage optical signal to be frequency routed; and

a plurality of output stage demultiplexers, each output stage demultiplexer being coupled one second stage output port of the second stage frequency router such that each second stage optical signal of the combined routed second stage optical signal is presented to an intended destination.

9. An optical router for routing a plurality of packets, N, of data, each packet of data having destination information, the optical router comprising:

a plurality of converters, each converter receiving a packet of data and providing an optical signal to be routed, each optical signal being colored in response to the destination information of the respective packet of data;

a plurality of combiners, one combiner combining at least two optical signals to be routed;

at least one frequency router having a plurality of input ports, M, and a plurality of output ports, M, at least one output port simultaneously receiving the at least two optical signals to be routed, and at least one output port simultaneously presenting at least two routed optical signals, the at least one frequency router routing optical signals by color;
a plurality of receivers; and

a plurality of splitters, one splitter splitting the at least two routed optical signals between at least two receivers such that at least one of the at least two receivers is tuned to pass one of the at least two routed optical signals to an intended destination.

10. The optical router of Claim 9, wherein each converter comprise a tunable light source for generating one optical signal, and for coloring the one optical signal in response to the destination information of the respective packet of data, and wherein each receiver comprises a tunable filter for tuning to a color to pass one of the at least two routed optical signals to an intended destination.

11. The optical router of Claim 10, wherein each converter comprises a converter for converting at least one packet of data to the one optical signal colored in response to destination information, and wherein each receiver comprises a converter for converting a routed optical signal into a routed packet of data.

12. The optical router of Claim 11, further comprising a scheduler for scheduling the conversion each packet of data into an optical signal and for scheduling the tuning of the tunable filter.

13. The optical converter of Claim 11, wherein the frequency router comprises:

at least one input waveguide;

at least one output waveguide;

a first and a second free space region, the first free space region coupled with the at least one input waveguide and the second free space region coupled with the at least one output waveguide; and

an optical grating having a plurality of unequal length waveguides, each unequal length waveguide coupled between the first free space region and the second free space region.

14. An optical router for routing a plurality of packets, N, of data, each packet of data having destination information, the optical router comprising:

a plurality of first stage converters, each converter receiving a packet of data and providing an optical signal to be routed, each optical signal being colored in response to the destination information of the respective packet of data;

a plurality of first stage combiners, one combiner combining at least two optical signals to be routed;

a first stage frequency router having a plurality of input ports, M, and a plurality of output ports, M, at least one output port simultaneously receiving the combined at least two optical signals to be routed, and at least one output port simultaneously presenting at least two first stage routed optical signals, the first stage frequency router routing optical signals by color;

a plurality of second stage converters, each second stage converter providing a second stage optical signal to be routed, each second stage optical signal being colored in response to the destination information of the respective packet of data;

a plurality of second stage demultiplexers, one second stage demultiplexer presenting each of the at least two routed optical signals from the first stage frequency router to a second stage converter;

a plurality of second stage combiners, one second stage combiner combining at least two second stage optical signals to be routed; and

a second stage frequency router having a plurality of second stage input ports, M, and a plurality of second stage output ports, M, at least one second stage input port simultaneously receiving at least two second stage optical signals to be routed, and at least one second stage output port simultaneously presenting at least two second stage routed optical signals, the second stage frequency router routing second stage optical signals by color.

15. The optical router of Claim **14**, further comprising a plurality of output stage receivers, each output stage receiver having an output stage demultiplexer, one output stage demultiplexer presenting each of the at least two second stage routed optical signals from the second stage frequency router to an intended destination.

16. The optical router of Claim **14**, further comprising a plurality of output stage receivers, each output stage receiver comprising:

at least two tunable filters for tuning to a color; and

a splitter coupled with the at least two tunable filters, wherein one output stage receiver splits the at least two second stage routed optical signals between the corresponding at least two tunable filters such that at least one of the at least two tunable filters is tuned to pass one of the at least two second stage routed optical signals to an intended destination.

17. The optical router of Claim 14, wherein each first stage converter comprises a first stage tunable light source for generating one optical signal, and for coloring the one optical signal in response to the destination information of the respective packet of data, each second stage converter comprises a second stage tunable light source for generating one second stage optical signal, and for coloring the one second stage optical signal in response to the destination information of the respective packet of data, and further comprising a scheduler for scheduling the coloring of each optical signal and each second stage optical signal.

18. The optical router of Claim 17, wherein each first stage converter comprises a first stage converter for converting at least one packet of data to the one optical signal colored in response to destination information of the respective packet of data, each second stage converter comprises a second stage converter for coloring one second stage optical signal in response to destination information of the respective packet of data.

19. The optical router of Claim 14, wherein at least one of the first and the second stage frequency routers comprise:

at least one input waveguide;

at least one output waveguide;

a first and a second free space region, the first free space region coupled with the at least one input waveguide and the second free space region coupled with the at least one output waveguide; and

an optical grating having a plurality of unequal length waveguides, each unequal length waveguide coupled between the first free space region and the second free space region.

20. The optical router of Claim **14**, wherein the first and the second stage frequency routers are formed by one frequency.

21. A method for routing optical signals comprising:

determining a first, second and third destination for a first, second and third packet of data, respectively;

generating a first, second and third carrier signal having a first, second and third frequency associated with the first, second and third destinations, respectively;

modulating the first, second and third carrier signals in response to the first, second and third packets of data to form a first, second and third optical signal; and

routing the first, second and third optical signals by a frequency routing device, the routing comprising:

simultaneously receiving in a first input of a frequency router at least two of the first, second and third signals; and

simultaneously presenting from a first output of the frequency router at least two of the first, second and third routed optical signals.

22. A method for routing a plurality of optical signals as a function of color through a router having a plurality of inputs and a plurality of outputs, the method comprising the steps of:

simultaneously receiving to at least one of the input ports at least two optical signals respectively colored as a function of destination information contained therein; and

simultaneously presenting from at least one of the output ports at least two optical signals routed as a function of their color.

23. The method of Claim **22**, further comprising the step of processing each of the presented at least two routed optical signals from the at least one of the output ports.

24. The method of Claim **22**, wherein the step of simultaneously applying to at least one of the input ports comprises the step of coloring each optical signal of the plurality is a further function of which input port of the plurality it is applied to.

25. A method for use in conjunction with a router which has a plurality of input ports and a plurality of output ports, said router being of a type which routes optical signals applied to its input ports to particular ones of said output ports as a function of the respective colors of said optical signals, the method:

applying each of a plurality of optical signals to a respective one of the input ports, this step including the step of concurrently applying to an individual one of said input ports at least two optical signals which have been respectively colored as a function of destination information contained in said optical signals, at least two of said optical signals being concurrently routed to a particular one of said output ports.

26. The invention of claim **25**, comprising the further step of concurrently removing from said particular one of said output ports said two optical signals concurrently routed thereto.

27. The invention of claim **25**, wherein the coloring of each said optical signal is a further function of which input port it is applied to.